What is Claimed is:

1. A method for making a pattern of a metal containing material on a substrate, said method comprising:

(a) applying a mesomorphous film of a metal complex on a surface of the substrate;

(b) exposing, in a first atmosphere, a first area, having a first shape, of said film to electromagnetic radiation from a first source to cause said metal complex in said first area to undergo a photo-chemical reaction, said reaction transforming said metal complex in said first area into a first metal containing material adherent to said substrate and one or more ligand byproducts at least some proportion of which are driven off during the course of said photochemical reaction, wherein the pattern comprises said first shape; and optionally

(c) driving off an unreacted amount of said metal complex and a remainder of said one or more ligand byproducts that are not driven off during the course of said photochemical reaction .

2. The method of claim 1 further comprising:

after said applying,

(d) exposing, in a second atmosphere, a second area, having a second shape, of said film to electromagnetic radiation from a second source to cause said metal complex in said second area to undergo a photo-chemical reaction, said reaction transforming said metal complex in said second area into a second metal containing material adherent to said substrate and one or more ligand byproducts at least some proportion of which are driven off during the course of said photochemical reaction, wherein the pattern additionally comprises said second shape; and

(e) driving off an unreacted amount of said metal complex and a remainder of said one or more ligand byproducts that are not driven off during the course of said photochemical reaction.

3. The method of claim 2 wherein said first area is adjacent to said second area and said first and second metal containing materials form a planar structure on said substrate.

4. The method of claim 2 wherein said steps of exposing said first and second areas of said film to electromagnetic radiation from said first and second sources respectively comprise aligning first and second masks over said substrate and illuminating surfaces of said masks away from said substrate with said electromagnetic radiation.

5. The method of claim 4 wherein said electromagnetic radiation comprises ultraviolet light.

6. The method of claim 2 wherein said first atmosphere comprises oxygen and said first metal containing material is a metal oxide.

7. The method of claim 1 wherein said first atmosphere comprises oxygen and said first metal containing material is a metal oxide.

8. The method of claim 7 wherein said first atmosphere is air.

9. The method of claim 7 further comprising:
removing remaining metal complex from said substrate, after said exposing said first area of said film to said electromagnetic radiation from said first source.

10. The method of claim 7 further comprising the step of reacting said metal oxide with a suitable chemical in a suitable atmosphere to reduce said metal oxide to a metal adherent to said substrate.

11. The method of claim 1 wherein a local temperature of said first metal containing material is maintained below an annealing temperature of said first metal containing material throughout said step of exposing said first area of said film to electromagnetic radiation from said first source.

12. The method of claim 11 wherein said local temperature is maintained below 320° C.

13. The method of claim 1 wherein said exposing said first area of said film to electromagnetic radiation comprises aligning a first mask over said substrate and illuminating a surface of said mask away from said substrate with said electromagnetic radiation from said first source.

14. The method of claim 13 wherein said electromagnetic radiation comprises ultraviolet light.

15. The method of claim 1 wherein said metal complex comprises one or more metal atoms

bonded to one or more ligands, at least one of said one or more ligands is bonded to said metal complex by a chemical bond which is broken by the absorption of electromagnetic radiation, and wherein said complex is thermally unstable when said at least one ligand is removed.

16. The method of claim 15 wherein said at least one ligand comprises a carboxylate group.

17. The method of claim 15 wherein at least one of said ligands is selected from the group consisting of: oxalato; halogens; hydrogen; hydroxy; cyano; carbonyl, nitro; nitrito; nitrate; nitrosyl; ethylene; acetylenes; thiocyanato; isothiocyanato; aquo; azides; carbonato; amine; pyridinyl; and thiocarbonyl.

18. The method of claim 15 wherein at least one of said ligands is selected from the group consisting of: alkoxy; alkyl; alkenyl; alkynyl; alicyclic; substituted alicyclic; alkyl bicyclic, such as norbornyl; phenyl; substituted phenyl; naphthyl, naphthylene; phenoxy; substituted phenoxy; carboxylate; substituted carboxylate; benzoate; substituted benzoate; and heterocyclic aromatic.

19. The method of claim 18 wherein any of said ligands that comprises one or more aryl groups does not comprise more than 26 carbon atoms.

19. The method of claim 18 wherein any of said ligands that does not comprise any aryl groups, does not comprise more than 12 carbon atoms.

20. The method of claim 19 wherein said at least one ligand has formula O_2CR wherein R is an organic group selected from the group consisting of alkyl, alkene and alkyne.

21. The method of claim 20 wherein R is $(CH_2)_4CH_3$.

22. The method of claim 17 wherein at least one of said ligands comprises one or more linking moieties, selected from the group consisting of: azo, diazo, oxy, amino, vinylene, phenylene, substituted phenylene, oxime, carboxy, and imine.

23. The method of claim 15 wherein at least one of said metal atoms is selected from the group consisting of: copper, nickel, platinum, palladium, ruthenium, rhenium, molybdenum,

chromium, tungsten and iron.

24. The method of claim 15 wherein at least one of said metal atoms is selected from the group consisting of: lead, mercury, tin, silicon and germanium.

25. The method of claim 15 wherein at least one of said metal atoms is selected from the group consisting of: rhenium and ruthenium.

26. The method of claim 17 wherein at least one of said ligands is a bidentate ligand selected from the group consisting of: β-diketonato, mono-thio-β-diketonato, dithiolene, salicyladehyde, benzalazine, ethane-1,2-dithiolato, ethane-1,2,-dioximate and dithiocarboxylate.

27. The method of claim 1 wherein said metal complex comprises two metal atoms bonded to one another.

28. The method of claim 15 wherein said absorption of said electromagnetic radiation places said metal complex in a ligand to metal charge transfer excited state in which a metal to ligand bond in said metal complex is unstable.

29. The method of claim 15 wherein said absorption of said electromagnetic radiation places said metal complex in a metal to ligand charge transfer excited state in which a metal to ligand bond in said metal complex is unstable.

30. The method of claim 15 wherein said absorption of said electromagnetic radiation places said metal complex in a d--d excited state such that a metal to ligand bond in said complex is unstable.

31. The method of claim 15 wherein said absorption of said electromagnetic radiation places said metal complex in an intramolecular charge transfer excited state such that a metal to ligand bond in said complex is unstable.

32. The method of claim 15 wherein said absorption of said electromagnetic radiation places at least one of said ligands in a localized ligand excited state wherein a bond between said excited ligand and said metal complex is unstable.

33. The method of claim 1 wherein said absorption of said electromagnetic radiation places said metal complex in a intramolecular charge transfer excited state such that at least one of said at least one ligands is unstable and degrades.

34. The method of claim 1 wherein said absorption of said electromagnetic radiation places at least one of said ligands in a localized ligand excited state wherein said excited ligand is unstable and degrades.

35. The method of claim 1 wherein said absorption of said electromagnetic radiation places said metal complex in a metal to ligand charge transfer excited state such that at least one of said at least one ligands is unstable and degrades.

36. The method of claim 1 wherein said absorption of said electromagnetic radiation places said metal complex in a ligand to metal charge transfer excited state such that at least one of said at least one ligands is unstable and degrades.

37. A method for making a pattern of a metal containing material on a substrate, said method comprising:

(a) applying a mesomorphous film of a metal complex on a surface of the substrate;

(b) exposing, in a first atmosphere, a first area, having a first shape, of said film to a first particle beam to cause said metal complex in said first area to be transformed into a first metal-containing material adherent to said substrate and one or more ligand byproducts of a first kind at least some proportion of which are driven off during the course of said photochemical reaction, wherein the pattern comprises the first shape;

(c) optionally driving off an unreacted amount of said metal complex and a remainder of said one or more ligand byproducts of a first kind that are not driven off during the course of said photochemical reaction;

(d) exposing, in a second atmosphere, a second area, having a second shape, of said film adjacent to said first area, to electromagnetic radiation of a wavelength suitable to cause said metal complex in said second area to undergo a photo-chemical reaction, said reaction transforming said metal complex in said second area into a second metal containing material adherent to said substrate and one or more ligand byproducts of a second kind at least some proportion of which are driven off during the course of said photochemical reaction; and optionally

(e) driving off an unreacted amount of said metal complex and a remainder of said one

or more ligand byproducts of a second kind that are not driven off during the course of said photochemical reaction.

38. The method of claim 37 wherein said particle beam is selected from a group consisting of an electron beam and an ion beam.

39. A thin mesomorphous film on a substrate, wherein the film comprises a photoreactive precursor metal complex.

40. The method of claim 1 additionally comprising repeating said applying, said exposing and said driving off for a second metal complex.

41. The method of claim 40 wherein said second metal complex is applied on top of said first metal containing material.

42. The method of claim 40 wherein said second metal complex is applied directly to said substrate.